
ENVIRONMENTAL Fact Sheet



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Carbon Monoxide: Health Information Summary

Carbon monoxide (CO) is a colorless, odorless, tasteless, and non-irritating, but potentially lethal gas produced by incomplete combustion of liquid, solid and gaseous fuels. CO may be produced from any furnace fired by fuel as well as from wood stoves, kerosene heaters, gas stoves and fireplaces. Other sources include emissions from motor vehicles, charcoal grills, and fuel-powered yard equipment. Perhaps the most familiar source of CO exposure is from running an automobile in an attached garage. A less obvious source of CO is propane-fueled, ice-surfacing machines in indoor skating rinks. The most common causes of CO buildup indoors are poorly vented or malfunctioning heaters and furnaces. The most common source of CO in outdoor air is from motor vehicle exhaust. Tobacco smoke is a minor source of CO.

Several hundred deaths due to CO poisoning occur each year in the United States, mainly from malfunctioning heating sources or dangerous practices such as using an unvented space heater and warming up an automobile in an attached-garage. The occurrence of CO poisoning events spikes during colder months when furnaces and space heaters are used. CO detectors can serve to warn occupants before CO reaches a level that may cause permanent injury or death. Refer to the "Suggested Reading and Reference" section to obtain information on CO detector selection.

Health Effects

Absorption and Mode of Action

Hemoglobin, a protein on red blood cells, functions to carry oxygen in the blood stream throughout the body. CO is absorbed through the lungs into the blood and will also combine with hemoglobin to form carboxyhemoglobin (COHb). CO binds to hemoglobin more strongly than does oxygen. COHb cannot transport oxygen, therefore depriving tissues and organs of oxygen. The organs most easily injured by oxygen deprivation are the heart and brain. COHb gives blood a cherry red color and victims of exposure sometimes have an abnormal red color to skin, nail beds and mucous membranes. The half-life of CoHb is about five hours, which means that the amount in the body will be reduced by 50 percent every five hours if exposure has stopped.

Everyone has a small percentage of COHb in the body, approximately 1.5 percent. Smokers typically have 3 to 4 percent. A level of 5 percent COHb can result from an adult working for six to eight hours in air with 50 parts per million (ppm) CO or for 15 minutes in air with 200 ppm CO. Generally, no adverse effects are expected below 10 percent COHb for healthy individuals. If CO is elevated in the air, the levels of COHb in the body will rise more rapidly if a person is physically active.

Short-Term (Acute) Effects

The effects of CO are related to the CO concentration in the air, the duration of the exposure, a person's health status, and the activity level of the individual. Symptoms in order of increasing severity of CO poisoning are headache, dizziness on exertion, fatigue, palpitations, nausea, vomiting, difficulty breathing on exertion, mental confusion, rapid heartbeat, visual disturbance, and muscle twitch. However, symptoms may not always appear in the order given above. Symptoms tend to become more severe as exposure and concentration increase, for example, mild headache or nausea progressing to more severe cases.

At very high CO levels, unconsciousness and eventually death may result. Acute exposure to very high levels not resulting in death may cause permanent damage to the heart and brain. Because many of the adverse effects experienced at low to moderately high CO levels are also symptoms of common acute illnesses, people may not consider CO poisoning as a possible cause.

Most people are not expected to experience symptoms below 70 ppm CO for acute exposure durations. As CO levels increase and remain above 70 ppm, symptoms may become noticeable. At levels approaching 200 ppm, symptoms become more severe. A concentration of 400 ppm will further intensify symptoms and is life threatening after three hours of exposure while 800 ppm results in unconsciousness within two hours and death within two to three hours. Exposure to about 13,000 ppm of CO can cause death after one to three minutes. CO exposure is the leading cause of immediate deaths due to building fires.

Long -Term (Chronic Effects)

Chronic exposure to low levels of CO can lead to a cluster of symptoms resembling the flu: headache, fatigue, muscle aches, nausea, vomiting, and a change in sensitivity to light, odor, and taste. Because symptoms of chronic exposure may differ from acute symptoms and are likely to be attributed to more common causes such as stress, infections, allergies, or psychological distress, chronic CO poisoning may be misdiagnosed. Additionally, tests that medical personnel often use to confirm a diagnosis of acute CO poisoning may not be effective in detecting chronic poisoning.

Carcinogenic Effects (Ability to Cause Cancer)

Although there are no human or animal studies investigating CO exposure and cancer, there is no information that would indicate it has any carcinogenic potential.

Teratogenic/Reproductive Effects

In pregnancy, the fetus may be susceptible to the effects of CO, suffering serious and even permanent damage to the central nervous system. Infants born to women acutely exposed to high concentrations of CO while pregnant can have brain damage. Persistent fetal exposure to low levels of CO may result in a decrease in an infant's mental capacity. Prolonged exposure to a high level of CO, for example 100 ppm or greater, during gestation may produce a decrease in birth weight and delayed brain development.

Populations at Special Risk

Sensitive populations include fetuses, those with chronic heart disease, young children, and the elderly, as well as people with chronic bronchitis or asthma. Medical evidence suggests that aggravation of angina (chest pain) and other symptoms of heart disease could occur at CO levels below 70 ppm, an exposure level that usually does not cause symptoms in healthy individuals.

Health Standards and Criteria

The Environmental Protection Agency has National Ambient Air Quality Standards (NAAQS) for CO of nine ppm averaged over an eight-hour exposure and 35 ppm for a one-hour exposure. The NAAQS are intended to protect sensitive populations such as those with heart disease. There is no non-occupational standard for indoor air.

The Occupational Safety and Health Administration has established occupational exposure limits of 50 ppm averaged over an eight-hour period (a Permissible Exposure Limit or PEL) and 200 ppm averaged over 15 minutes as a short term exposure limit. The occupational limit established by the American Conference of Governmental Industrial Hygienists, referred to as the Threshold Limit Value, is 25 ppm.

Suggested Reading and References

Protect Your Family and Yourself from Carbon Monoxide Poisoning. U.S. EPA: Office of Air and Radiation. October, 1996. www.epa.gov/iaq/pubs/coftsht.html

Carbon Monoxide Poisoning Fact Sheet. Centers for Disease Control and Prevention (CDC). Atlanta, GA. <http://www.cdc.gov/co/faqs.htm>

Product Safety Tips: CO Alarms. Underwriters Laboratories, Inc. Northbrook, IL
<http://www.ul.com/consumers/co.html>

Carbon Monoxide Questions and Answers. CPSC document #466. U.S. Consumer Product Safety Commission. Bethesda, MD. <http://www.cpsc.gov/cpscpub/pubs/466.html>

Casarett and Doull's Toxicology: The Basic Science of Poisons, Sixth Edition. Klaassen, C.D., ed. McGraw-Hill Publishing Co., Inc., New York, 2001.

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